

WHAT IS CLAIMED IS:

1           1.       A method of aligning a plurality of images, the method comprising:  
2           providing a marker on a first image and a second image;  
3           overlapping the first image and the second image to match the marker on the  
4 first image with the marker on the second image; and  
5           computing an absolute difference value between the pixel intensities of the  
6 overlapping portions of the first and second images to validate alignment between the first  
7 and second images.

1           2.       The method of claim 1 comprising realigning at least one of the first  
2 image and second image if it is determined that the first and second images are misaligned.

1           3.       The method of claim 1 wherein the first and second images are  
2 obtained from a digital radiography device.

1           4.       The method of claim 1 comprising blending an overlap section of the  
2 first image and the second image.

1           5.       The method of claim 4 wherein blending comprises:  
2           computing a pixel intensity of the pixels of first image in the overlap section;  
3           computing a pixel intensity of the pixels of the second image in the overlap  
4 section that overlap the pixels of the first image in the overlap section; and  
5           displaying for each pixel in the overlap section a largest pixel intensity of the  
6 overlapping pixels from the first image and second image.

1           6.       The method of claim 4 wherein blending comprises:  
2           computing a pixel intensity of the pixels of first image in the overlap section;  
3           computing a pixel intensity of the pixels of the second image in the overlap  
4 section that overlap the pixels of the first image in the overlap section; and  
5           displaying for each pixel in the overlap section a smallest computed pixel  
6 intensity from the overlapping pixels from the first image and second image.

1           7.       The method of claim 4 wherein blending comprises:  
2           computing a pixel intensity of the pixels of first image in the overlap section;

3           computing a pixel intensity of the pixels of the second image in the overlap  
4 section that overlap the pixels of the first image in the overlap section; and  
5           displaying for each pixel in the overlap section an average pixel intensity of  
6 the overlapping pixels of the first and second images in the overlap section.

1           8.     The method of claim 4 wherein blending comprises providing a  
2 smooth transition between the first image and second image by selectively providing from  
3 0% of the first image to 100% of the first image in the overlap section.

1           9.     The method of claim 4 wherein blending comprises providing a  
2 smooth transition between the first image and second image by selectively providing from  
3 0% to 100% of the second image.

1           10.    The method of claim 4 wherein the first and second images comprise a  
2 plurality of pixels, each of the pixels having a pixel intensity, wherein in the overlap section a  
3 portion of the pixels in the first image overlap a portion of the pixels in the second image,  
4 wherein the overlap section comprises a first end and a second end, wherein blending  
5 comprises:

6           displaying 100% of the pixel intensity of the first image at the first end of the  
7 overlap section;

8           displaying 50% of the pixel intensity of the first image with 50% of the pixel  
9 intensity of the overlapping pixels of the second image at a halfway point of the overlap  
10 section; and

11          displaying 100% of the pixel intensity of the second image at the second end  
12 of the overlap section.

1           11.    The method of claim 10 wherein blending further comprises displaying  
2 pixel intensities from the first image and the second image with a weighting for the  
3 combination which changes in a non-linear manner from the first end of the overlap section  
4 to the second end of the overlap section.

1           12.    The method of claim 10 wherein blending further comprises displaying  
2 pixel intensities from the first image and the second image with a weighting for the  
3 combination which changes in a linear manner from the first end of the overlap section to the  
4 second end of the overlap section.

1 13. A method of stitching a plurality of images, the method comprising:  
2 providing a marker on a first image and a second image;  
3 overlapping the first image and the second image to create an overlap section,  
4 wherein overlapping matches the marker on the first image with the marker on the second  
5 image;  
6 calculating an absolute difference between the pixel intensity values of the  
7 overlapping portions of the first and second images in the overlap section so as to validate  
8 alignment between the first and second images; and  
9 blending the overlap section of the first image and the second image.

1 14. The method of claim 13 wherein the first and second images are  
2 obtained from a digital radiography device.

1 15. The method of claim 13 wherein blending comprises:  
2 computing a pixel intensity of the pixels of first image in the overlap section;  
3 computing a pixel intensity of the pixels of the second image in the overlap  
4 section that overlap the pixels of the first image in the overlap section; and  
5 displaying for each pixel in the overlap section a largest pixel intensity of the  
6 overlapping pixels from the first image and second image.

1 16. The method of claim 13 wherein blending comprises:  
2 computing a pixel intensity of the pixels of first image in the overlap section;  
3 computing a pixel intensity of the pixels of the second image in the overlap  
4 section that overlap the pixels of the first image in the overlap section; and  
5 displaying for each pixel in the overlap section a smallest computed pixel  
6 intensity from the overlapping pixels from the first image and second image.

1 17. The method of claim 13 wherein blending comprises:  
2 computing a pixel intensity of the pixels of first image in the overlap section;  
3 computing a pixel intensity of the pixels of the second image in the overlap  
4 section that overlap the pixels of the first image in the overlap section; and  
5 displaying for each pixel in the overlap section an average pixel intensity of  
6 the overlapping pixels of the first and second images in the overlap section.

1 18. The method of claim 13 wherein blending comprises providing a  
2 smooth transition between the first image and second image by selectively providing from  
3 0% of the first image to 100% of the first image in the overlap section.

1 19. The method of claim 13 wherein blending comprises providing a  
2 smooth transition between the first image and second image by selectively providing from  
3 0% to 100% of the second image.

1 20. The method of claim 13 wherein the first and second images comprise  
2 a plurality of pixels, each of the pixels having a pixel intensity, wherein in the overlap section  
3 a portion of the pixels in the first image overlap a portion of the pixels in the second image,  
4 wherein the overlap section comprises a first end and a second end, wherein blending  
5 comprises:

6 displaying 100% of the pixel intensity of the first image at the first end of the  
7 overlap section;

8 displaying 50% of the pixel intensity of the first image with 50% of the pixel  
9 intensity of the overlapping pixels of the second image at a halfway point of the overlap  
10 section; and

11 displaying 100% of the pixel intensity of the second image at the second end  
12 of the overlap section.

1 21. The method of claim 20 wherein blending further comprises displaying  
2 pixel intensities from the first image and the second image with a weighting for the  
3 combination which changes in a non-linear manner from the first end of the overlap section  
4 to the second end of the overlap section.

1 22. The method of claim 20 wherein blending further comprises displaying  
2 pixel intensities from the first image and the second image with a weighting for the  
3 combination which changes in a linear manner from the first end of the overlap section to the  
4 second end of the overlap section.

1 23. The method of claim 13 wherein the overlap section is black when the  
2 overlapping pixels of the first image and the second image have the same pixel intensity.

1 24. The method of claim 23 wherein calculating is in real-time.

1           25.    The method of claim 13 wherein providing a marker comprises  
2 marking a first point on the first image and a second point on the second image, and wherein  
3 overlapping comprises matching the first and second points and keeping the orientation of the  
4 first and second image fixed.

1           26.    The method of claim 13 wherein providing a marker comprises  
2 marking a first point and a first line on the first image and a second point and second line on  
3 the second image, wherein superimposing comprises:  
4           matching the first points and second points; and  
5           rotating one of the first and second images so that the first line and second line  
6 are parallel.

1           27.    The method of claim 13 wherein providing a marker comprises  
2 marking a first line on the first image and a second line on the second image so that a last  
3 point of the first line and a first point of the second line are matched and wherein overlapping  
4 comprises rotating at least one of the images so as to make the first line and second line  
5 parallel.

1           28.    The method of claim 13 comprising adjusting a position of at least one  
2 of the first and second images by a plurality of fixed steps.

1           29.    The method of claim 28 wherein the fixed step comprises a one pixel  
2 displacement.

1           30.    The method of claim 28 wherein the fixed steps comprise a 10 pixel  
2 displacement.

1           31.    The method of claim 28 wherein adjusting of the position of the  
2 image(s) is made in a fixed step by the use of a keyboard key or combination of keys.

1           32.    The method of claim 28 wherein the first image is rotated in a plurality  
2 of fixed steps by the use of a keyboard key.

1           33.    The method of claim 32 wherein the steps comprise a one quarter  
2 degree rotation.

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- 1 34. The method of claim 32 wherein the fixed step comprises a one degree  
2 rotation.
- 1 35. The method of claim 32 wherein the fixed step comprises a ten degree  
2 rotation.
- 1 36. The method of claim 28 comprising tracking the position of the moved  
2 image in real time.
- 1 37. The method of claim 28 comprising adjusting a center of rotation of at  
2 least one of the first and second image.
- 1 38. The method of claim 37 wherein adjusting comprises clicking and  
2 dragging a cursor over a selected image.
- 1 39. A method of stitching a first image and a second image:  
2 providing a first image and a second image;  
3 overlapping a portion of the first image with a portion of the second image to  
4 create an overlap section;  
5 calculating pixel intensities of the first image and the second image; and  
6 validating alignment of the first image and second image by displaying an  
7 absolute difference between a pixel intensities of the first image and the second image in the  
8 overlap section.
- 1 40. A method of blending at least a first and second radiographic image in  
2 an overlap section of a stitched image, the method comprising:  
3 computing a pixel intensity of the first image and second image in the overlap  
4 section of the stitched image; and  
5 displaying a smooth transition in the overlap section between the first and  
6 second image from 0% to 100% of the pixel intensity of the second image.
- 1 41. The method of claim 40 wherein displaying the smooth transition  
2 comprises:  
3 displaying 100% of the pixel intensity first image at a first end of the overlap  
4 section;

5 blending 50% of the pixel intensity of the first and second images at a half  
6 point; and  
7 displaying 100% of the pixel intensity of the second image at a second end of  
8 the overlap section;  
9 wherein the distribution of the smooth transition of the pixel intensity between  
10 the first end, half point, and second end varies with linear weighting.

1 42. The method of claim 40 wherein displaying the smooth transition  
2 comprises:  
3 displaying 100% of the pixel intensity of the first image at a first end of the  
4 overlap section;  
5 blending 50% of the pixel intensity of the first and second image at the half  
6 point; and  
7 displaying 100% of the pixel intensity of the second image at a second end of  
8 the overlap section;  
9 wherein the distribution of the smooth transition of the pixel intensity between  
10 the first end, second end, and half point varies with non-linear weighting.

1 43. A method of stitching at least a first and second image, the method  
2 comprising:  
3 providing a first and second image, wherein each of the first and second image  
4 comprises a plurality of pixels;  
5 overlapping a portion of the first image and the second image to create an  
6 overlap section;  
7 computing on a pixel by pixel basis an absolute difference value between the  
8 overlapping pixels of first image and the second image in the overlap section; and  
9 displaying the absolute difference between the pixel intensities of the  
10 overlapping pixels of the first image and the second image.

1 44. The method of claim 43 wherein the displaying comprises providing a  
2 black overlap section when the first image and second image coincide exactly within the  
3 overlap section.

1 45. A method of blending at least a first and second stitched image,  
2 wherein the first image and second image comprises pixels, wherein the stitched image

3 defines an overlap section in which portions of the pixel in the first image overlap with pixels  
4 in the second image, the method comprising:  
5           computing a pixel intensity for each of the pixels from the first and second  
6 image in the overlap section; and  
7           displaying a largest computed pixel intensity of the overlapping pixels from  
8 the first and second images.

1           46. A method of blending at least a first and second stitched image,  
2 wherein the first image and second image comprises pixels, wherein the stitched image  
3 defines an overlap section in which portions of the pixel in the first image overlap with pixels  
4 in the second image, the method comprising:  
5           computing a pixel intensity for each of the pixels from the first and second  
6 image in the overlap section; and  
7           displaying a smallest computed pixel intensity of the overlapping pixels from  
8 the first and second images.

1           47. A method of stitching a plurality of images, the method comprising:  
2 providing a first image and a second image;  
3 allowing a user to choose one of at least two types of markers to align the first  
4 and second images;  
5 marking the first image and second image with a chosen marker; and  
6 aligning the markers to stitch the first and second images together.

1           48. The method of claim 47 wherein allowing comprises letting the user  
2 choose from at least two of a single point marker, two point markers, a line marker, and a  
3 point and line marker.

1           49. The method of claim 47 wherein marking comprises marking the first  
2 image and second image with a point marker, and wherein aligning comprises performing at  
3 least one of a translation (with no rotation) of one of the images to align the markers on the  
4 first image and second image.

1           50. The method of claim 47 wherein marking comprises marking the first  
2 image and second image with two point markers, and wherein aligning comprises performing  
3 at least one of a translation and rotation of one of the images to align the two markers on the  
4 first image with the two markers on the second image.



1           51.    The method of claim 47 wherein marking comprises marking the first  
2 image and second image with a point marker and a line marker, and wherein aligning  
3 comprises performing at least one of a translation and rotation of one of the images to match  
4 the point markers on the first image and second image and to make the line markers parallel.

1           52.    The method of claim 47 wherein marking comprises marking the first  
2 image and second image with a line marker, and wherein aligning comprises performing at  
3 least one of a translation and rotation of one of the images to match one end of the line  
4 marker on the first image with an end of the line marker on the second image and to align the  
5 images such that the lines are parallel.

1           53.    The method of claim 47 comprising blending the images in an overlap  
2 section of the stitched image.

1           54.    A method of stitching a plurality of images, the method comprising:  
2 providing a first image and a second image;  
3 allowing a user to choose one of at least two of the following methods of  
4 marking:

5                   marking a first point on the first image and a second point on the  
6 second image;

7                   marking a first and second point on the first image and a third and  
8 fourth point on the second image;

9                   marking a first point and a first line on the first image and a second  
10 point and second line on the second image;

11                  marking a first line on the first image and a second line on the second  
12 image;

13                  marking the first image and second image with a chosen marker; and  
14 aligning the markers to stitch the first and second images together.

1           55.    The method of claim 54 wherein marking comprises placing the first  
2 point on the first image and the second point on the second image , wherein aligning further  
3 comprises keeping the orientation of the first and second image fixed.

1           56.    The method of claim 54 wherein marking comprises placing the first  
2 point and the first line on the first image and the second point and second line on the second

3 image, wherein aligning comprises matching the first points and second points and rotating  
4 one of the first and second images so that the first line and second line are parallel.

1 57. The method of claim 54 wherein marking comprises placing the first  
2 point and second point on the first image and the third point and fourth point on the second  
3 image, wherein aligning comprises matching the first point with the third point and rotating  
4 one of the first image and second image until the second point and fourth points are matched.

1 58. The method of claim 54 wherein marking comprises placing the first  
2 line on the first image and the second line on the second image, wherein aligning comprises  
3 overlapping the first line and second line so that a last point of the first line and a first point  
4 of the second line are matched, wherein at least one of the first and second images are rotated  
5 so as to make the first line and second line parallel.

1 59. A stitched image comprising:  
2 a first portion comprising a first portion of a first image;  
3 a second portion comprising a first portion of a second image; and  
4 an overlap portion comprising a blended combination of a second portion of  
5 the first image and a second portion of the second image.

1 60. The stitched image of claim 59 wherein the overlap portion comprises  
2 a marker.

1 61. The stitched image of claim 59 wherein the stitched image comprises a  
2 DICOM dataset.

1 62. A method of measuring an angle of scoliosis, the method comprising:  
2 providing a first radiographic image of at least a portion of the thoracic and  
3 upper lumbar spine;  
4 providing a second radiographic image of at least a portion of the lumbar and  
5 lower thoracic spine;  
6 stitching the first radiographic image to the second radiographic image; and  
7 measuring an angle of scoliosis on the stitched radiographic image.

1 63. The method of claim 62 wherein measuring comprises placing two  
2 lines on the radiographic image and measuring the angle between the two lines.

1                   64.     The method of claim 62 wherein measuring comprises:  
2                   drawing a line in a disk space between two thoracic vertebrae parallel to an  
3 inferior surface of an upper vertebrae;  
4                   drawing a second line in a disk space between two lumbar vertebrae, parallel  
5 to the inferior surface of an upper lumbar vertebrae;  
6                   drawing a line perpendicular to each of the first and second lines such that the  
7 lines intersect; and  
8                   calculating the angle at an intersection.

1                   65.     The method of claim 62 comprising blending an overlap section of the  
2 first radiographic image and the second radiographic image.

1                   66.     The method of claim 65 comprising validating a registration of the first  
2 image and second image by displaying an absolute difference between the first image and  
3 second image in the overlap section.

1                   67.     A method of stitching a first image and a second image, the method  
2 comprising:  
3                   providing a first marker on a first image and a second marker on the second  
4 image, wherein each of the first image and second image comprise a plurality of pixels;  
5                   matching the first and second markers, wherein matching overlaps a portion of  
6 the first image and a portion of the second image;  
7                   validating alignment of the first image and second image by displaying an  
8 absolute difference of pixel intensities of the overlapping portions of the first image and  
9 second image; and  
10                  blending the overlapping portions of the first image and second image.

1                   68.     A method of stitching a first image and a second image, the method  
2 comprising:  
3                   providing at least a first marker on a first image and at least a second marker  
4 on the second image, wherein the first image and second image comprise a plurality of pixels;  
5                   matching the first and second markers, wherein matching overlaps a portion of  
6 the first image and a portion of the second image; and  
7                   selecting a desired blending method from a plurality of blending methods; and

- 8                    using the selected blending method to blend the overlapping portions of the
- 9   first image and second image.